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Geographical variations in fertility and transition to second and third birth in Britain[☆]

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A B S T R A C T

Geographical variations in fertility have been observed within several countries in Northern Europe, with higher fertility in rural areas, smaller settlements and city suburbs. However, the processes underlying such fertility variations across residential contexts are not well understood. This paper contributes to the on-going debate by looking at local variations in fertility in Britain. It aims to disentangle the relative contribution of a number of factors, including the socio-economic characteristics of individuals, housing conditions, patterns of residential relocation and lastly, contextual factors stricto sensu. In addition, it seeks to identify those aspects of reproductive behaviour which are more likely to be associated with the observed spatial differences, and to distinguish between those that may be influenced by local context and those that respond to social influences at different scales. The focus is on local fertility contexts which, we argue, have the potential to influence the fertility behaviour of individuals through processes of social learning.

Individual level data from the British Household Panel Survey and methods of event history analysis are used to explore women's transitions to second and third order births in Britain in the early 21st century. Our findings indicate that individual reproductive life paths respond to a variety of social processes acting at various scales, and that these influences vary by birth order. Most interestingly, local fertility contexts influence transition to first birth but not transition to higher order births, which are mainly associated with individual characteristics of women and their partners. Dominant spacing effects, however, suggest that local contexts have an indirect impact on second and third births through age at the onset of childbearing. The study demonstrates the importance of considering social interaction theories, and their extension to scale-sensitive spatial contexts in which these interactions take place, when analysing geographical variations in fertility. Future research seeking to explain subnational fertility variations must recognize the importance of developing theoretical understandings to inform empirical work.

1. Introduction

Spatial variations in fertility have been noted within several European countries. Observed differences between urban and rural areas, and by settlement size, show similar patterns of lower fertility in cities and higher fertility in less densely populated settlements (Kulu, 2013a; Kulu, Vikat, & Andersson, 2007). Further, relatively high fertility

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has been found around the periphery of large cities in Finland (Kulu & Boyle, 2009), Sweden (Kulu, Boyle, & Andersson, 2009) and Scotland (Boyle, Graham, & Feng, 2007). However, the processes underlying such fertility variations across residential contexts are still not fully understood.

This paper contributes to the on-going debate on local variations in fertility by examining transitions to second and third order births in Britain. Compared to other developed countries, childbearing patterns within UK are notable for the increasing heterogeneity in the quantum and/or timing of births among different population subgroups (Sigle-Rushton, 2008). This polarization of fertility behaviour is given spatial expression in the differing geographies of fertility. Our research is explicitly directed towards a closer understanding of the processes underlying the variations of fertility over space, which are also likely to vary by birth order. It aims to disentangle the relative contribution of a number of factors, including the socio-economic characteristics of individuals, housing conditions, patterns of residential relocation and lastly, contextual factors *stricto sensu*. In addition, it seeks to identify those aspects of reproductive behaviour which are more likely to be associated with the observed spatial differences, and to distinguish between those that may be influenced by the local context and those that respond to social influences at different scales.

However, any speculation on contextual effects on individual childbearing behaviour requires a prior reflection on how 'context' is defined and measured and a fuller understanding of how contextual effects operate. In this work we focus on 'local fertility contexts'. These are geographically defined, but built up from small spatial units so that they capture the immediate social context surrounding individuals. We argue that this local fertility geography has the potential to influence the fertility behaviour of individuals through mechanisms of social learning. Our previous work (Graham, Fiori, & Feng, 2012) showed that these local fertility contexts are indeed associated with significant differences in first birth risks, at least in large cities. In order to gain further understanding, this paper explores the transitions to second and third order births of women in Britain in the early 21st century which we expect may differ from transitions to first birth in terms of the major drivers and mechanisms of change. The analysis employs individual data from the British Household Panel Survey (for the years 1999–2008), which contains detailed information on individuals and their households, on housing characteristics and residential changes and, most importantly for our purposes, an indication of place of residence geo-coded to small areas.

The paper is structured as follows. The next section opens with a brief overview of trends and features of recent fertility in Britain; it then reviews the relevant literature on spatial variations in fertility and the underlying mechanisms. The second section presents in detail the aim of the study and the research hypotheses. The third section is devoted to a description of the data, methods, and variables. The results of the analyses are described in the fourth section. The final section offers a general discussion of the study and its findings, and it is then followed by some concluding remarks.

2. Fertility variations in Britain: current trends and underlying processes

Over the last two decades, fertility levels in the United Kingdom have been high relative to other European countries. After reaching its minimum point of 1.63 children per woman in 2001, the total fertility rate (TFR) increased every year since to 1.91 children per woman in 2011. The trends observed in the constituent countries mirror the national average, albeit with differences in levels. In particular, fertility in Scotland has been systematically lower than in England and Wales in recent decades (Office for National Statistics, 2012). Cohort measures also indicate that – for England and Wales[1] – estimated average family size varies around 2 children for the cohorts of women completing childbearing in the first decade of this century. Although families with two children are the most prevalent, this figure conceals a greater dispersion of family size compared to that observed in other European countries with similar fertility levels. First, women born in England and Wales have one of the highest levels of childlessness in Europe (16–20% of women born in 1955–1965). Second, there are also a higher number of larger families than elsewhere. The percentage of women giving birth to an only child, on the other hand, is among the lowest in Europe (12–13% among the cohorts born in 1955–1965) (Breton & Prioux, 2009; Office for National Statistics, 2011; Shkolnikov, Andreev, Houle, & Vaupel, 2007). Thus, although a relatively large number of women choose not to have children, almost all of those who do become mothers have two or more children (Jefferies, 2001). Similarly dispersed is the tempo of childbearing over the life course. For women, the peak of fertility has shifted to older ages, from the late twenties to the early thirties, and fertility in the late thirties is also increasing (General Register Office for Scotland, 2011; Office for National Statistics, 2011). Despite this general trend of postponement, however, Britain is unique in Europe for its relatively high level of births to women below the age of 20, and this has remained fairly stable over time (Rendall et al., 2005; Sigle-Rushton, 2008).

The dispersions of both the tempo and the quantum of childbearing suggest the existence of a large diversity, perhaps larger than elsewhere, in childbearing across demographic and social groups. Indeed, several studies have highlighted the existence of a pronounced polarization of fertility behaviour by ethnicity, educational level and occupational status (Coleman & Dubuc, 2010; Ekert-Jaffe, Joshi, Lynch, Mougin, & Rendall, 2002; Ní Bhrolcháin

[1] Whereas estimates of true birth order are regularly produced for England and Wales using the General Household Survey, they are not currently produced for Scotland. The first (and only, to our knowledge) official attempt was made by Chamberlain and Smallwood (2004). Their estimates show that the cohorts of Scottish women born in 1950–1955 have parity distributions similar to their English and Welsh counterparts, whereas they suggest higher childlessness and smaller families (and thus lower completed family sizes) for the cohorts born in 1960 and later.

& Beaujouan, 2012; Rendall et al., 2010; Rendall, Ekert-Jaffe, Joshi, Lynch, & Mougin, 2009; Sigle-Rushton, 2008, among others). The heterogeneity of British women's fertility behaviours also finds expression at the geographical level. Tromans, Natamba, Jefferies, and Norman (2008) observed that fertility trends within individual local authorities are wide-ranging and can differ quite substantially from the trends of the region within which they are located. Using a more refined geography for Scotland, Boyle et al. (2007) further noticed that low fertility rates tend to be clustered in central urban areas whereas the surrounding peri-urban fringes contain pockets of relatively high fertility. A similar picture is apparent in an extension of the study to cover the whole of Britain (Graham et al., 2012). Furthermore, these studies reported that local contexts with relatively high fertility generally display much higher birth rates at younger reproductive ages, whereas fertility levels at older ages are very similar. The variability observed at the local level might – at least in part – be a reflection of the residential sorting of the population, and of the polarization of childbearing behaviour according to the socio-economic characteristics of individuals. Thus, fertility levels might vary simply because different people live in different places. However, the analyses of Boyle et al. (2007) challenged this view, calling for further research in order to understand the processes behind the observed spatial variation.

Spatial aspects of fertility in Western countries and their underlying drivers have recently attracted a growing interest (Basten, Huinink, & Klüsener, 2012; Boyle et al., 2007; De Beer & Deerenberg, 2007; Hank, 2001; Kulu, 2013a; Kulu & Boyle, 2009; Kulu et al., 2007, 2009; Meggiolaro, 2010). These studies differ with respect to their approaches (micro, macro, micro-macro) and to the geographical scale of their analyses (by settlement size, by urban/rural categories, by administrative areas at the regional or sub-regional level). However, and in line with the studies on Britain cited above, they also suggest that the compositional hypothesis alone cannot explain the geographical patterning of fertility. Individual demographic and socio-economic characteristics account for some but not all of the observed variability. Rather, a more complex system of mechanisms and factors, often difficult to disentangle, is suggested as a possible explanation. Thus, besides *compositional* factors, other paths of influence are discussed, which can be grouped within two broad categories: *contextual* and *selection* effects (for a systematization, see Basten et al., 2012, or Kulu & Boyle, 2009).

The *contextual* hypothesis highlights the effects related to the immediate living environment, positing that aspects of the area where individuals live may encourage or discourage their childbearing. For instance, structural factors such as the availability and affordability of housing, family-oriented services and infrastructure, or economic opportunities and constraints related to the direct and indirect cost of children in some contexts compared to others are often reported as contextual factors which might potentially account for observed spatial variations in fertility. Further, cultural factors such as family-related values, gender roles or other social norms, as well as social interactions within social networks, constitute particular dimensions of the local environment which are thought to shape fertility. The *selection* hypothesis, in contrast, refers to the idea that women (or couples) with certain fertility expectations 'select themselves' into certain areas through their choices of where to live. Thus, for instance, those intending to have large families would move to areas that are perceived as more suitable for raising children, whereas those with non-traditional child-free lifestyles may opt to live in larger urban areas.

The boundaries of what falls within one category of influence or the other are in fact much more blurred than is often assumed as it is difficult to distinguish contextual effects per se from the effects of composition or selection which in turn shape the context (Basten et al., 2012). Further, ascertaining contextual effects will depend on how context is defined and measured, as well as on the underlying assumptions as to how and why specific contexts matter for childbearing. In this respect, it appears necessary to turn attention from the study of aggregate fertility differentials and to focus on individual life course trajectories and fertility outcomes. This will allow us to identify the components that contribute to the overall picture of spatially varying fertility levels and to tease out the relative contributions of composition, selection and context to transitions to second and third birth during the individual's reproductive career. Our expectation is that the contributions of each of these components will differ depending on birth order.

In a recent study on fertility variations in Finland, Kulu (2013a) observed a more pronounced gradient by settlement size for risks of first and third order births compared to second births. First birth risks were significantly lower in Helsinki compared to other cities, whereas third birth risks were significantly higher in small towns and rural areas. A previous study (Kulu & Boyle, 2009) focused instead on the distinction between urban, suburban and rural areas, showing significantly higher suburban fertility for all birth orders. Similarly, Kulu et al. (2009) reported that women in Swedish suburban municipalities had higher first and second birth rates than women living in central cities; however, no differences were observed in the third birth rates of those who already had two children. On the other hand, larger differences in third compared to second birth risks across contexts emerged for Sweden when context was measured as settlement size (Kulu et al., 2007). Differences across contexts thus tended to be more prominent with respect to first births but were evident also for higher orders births, albeit more sensitive to the definition of the context. However, for some variables typically included when modelling spatial variation in birth risks, it remains unclear whether they are individual measures, context measures, or both.

Besides the usual socio-demographic characteristics known to be associated with different reproductive paths, the above studies examined the role of housing, mobility and of the different chances to fulfil personal expectations of both proper housing and ideal family size in smaller places or peripheral areas compared to the big urban centres (see also Clark & Huang, 2003; and Kulu, 2008). Nevertheless, extending the explanatory framework to include – besides their socio-demographic characteristics – the housing and mobility choices of households only partly accounts for, and does not entirely eliminate, observed differences in fertility across contexts. Kohler (2000, 2001) suggested that theories of social interaction might be helpful in understanding divergences in the demographic behaviour of different populations. Describing how social interactions may emerge, he mentioned several mechanisms (e.g. social learning and influence, social norms and preferences – for an extensive review, see Kohler, 2000). The relevance of social interactions was emphasized also in Kohler, Billari, and Ortega (2002) in the context of lowest-low fertility, where they argued that social interactions, either impersonal or personal, might induce multiplier effects or multiple equilibria. Several of the studies on spatial variation in fertility reviewed above acknowledged the importance of the social, cultural and normative milieu to understanding the persistence of significant differences across geographical contexts. For example, De Beer and Deerenberg (2007) suggested that norms might have a stronger impact in rural areas, whereas Kulu and colleagues (Kulu, 2013a; Kulu & Boyle, 2009; Kulu et al., 2007, 2009) highlighted the existence of distinct normative pressures in urban versus rural areas and of different opportunities and costs of fulfilling personal and social expectations in the two contexts. They did not, however, pursue these speculations in any detail. Indeed Kulu (2013a) suggested that qualitative research would be needed to reveal the underlying processes.

3. Aim of the work and research questions

The present study builds on previous work that found significant spatial variations in fertility within Britain (Boyle et al., 2007), and recognizes the need to shed light on the processes underlying such variations. By looking at parity specific fertility, it aims at gaining a better understanding of the dynamics behind any aggregate fertility differentials across geographical contexts. Specifically, the paper focuses on '*local fertility contexts*' as a theoretically-based definition of context for the study of birth order transitions (see Graham et al., 2012). These contexts are conceptualized as areas around an individual's place of residence which provide opportunities for passive social learning. The hypothesized mechanism operates through the observation of the presence (or absence) of mothers and children in the area, with whom the individual may identify. The effect on individual fertility behaviour is likely to be most evident in areas where the ratio of children to potential mothers is either higher or lower than average, thus encouraging higher parity births or reinforcing childlessness. We interpret these contexts as markers for local 'cultures' of fertility, following Hammel's (1990) suggestion that any successful incorporation of the anthropological concept of culture in demographic explanations should proceed through social contextualization. Such contextualization relies on comparative studies of relatively small socio-spatial units. Our research questions also draw from the growing body of literature on social and family influences on fertility (Balbo & Mills, 2011; Bernardi, 2003). Further, we argue that the local fertility geography adopted in this paper (see below) has the potential to influence the fertility behaviour of individuals who live in (or move into) these areas through mechanisms of social learning (Montgomery & Casterline, 1996).

The paper addresses three main research questions.

1. *Do transitions to second and to third birth differ across local fertility contexts?*

   Significant variations across local contexts have been observed with respect to the onset of childbearing, as women living in the city centres of large urban areas are less likely to become first-time mothers (Graham et al., 2012). This paper extends our previous analysis by focusing on transitions to second and to third birth. The purpose is to assess whether aggregate fertility differentials across local contexts are associated only with the different proportions of women postponing – and perhaps eventually foregoing – fertility in each local context, or whether differences in the proportions of women who go on to have two or more children require different explanations. Previous research in other European countries suggests that context may have greater influence on the likelihood of having a first child than on subsequent births, especially second births (Kulu et al., 2007; Kulu, 2013a). We expect that this second-birth difference may be even more pronounced in Britain, where normative preferences appear to favour two or no children over having an 'only' child. The influence of local context on third order births may differ again, as it is a minority of those who start a family who go on to have more than two children.
2. *To what extent do compositional and selection effects account for differences in the transition to second and to third birth across local contexts?*

   The difficulty of distinguishing contextual effects from compositional and selection effects is well recognized in the literature and, in this respect, we follow an accepted procedure in our models by explicitly controlling for a range of individual/household characteristics and for migration. By including house type and size, as well as tenure, as time-variant variables, we move the empirical analysis beyond most other studies. More importantly, we resist any simplified interpretation of such variables as indicators of composition alone. The geographical clustering of house types, for example, strongly suggests that the type and size of house an individual occupies says as much about the area in which they live as it does about the individual themselves. Thus, while we expect these variables to be significant predictors of individual transitions to second and third births in Britain and to account for some of the observed variability at the local level, we offer a different interpretation of their role in the context versus composition debate. Moreover, by examining second and third births separately, our purpose is to identify both similarities and differences in the main drivers of birth risks for the two parity transitions.

3. *Are there additional social influences on the transition to second and to third birth?*

   The last research question focuses more explicitly on social influences on the transitions to second and to third birth. We consider the frequency of women's social exchanges with family and friends in order to distinguish the effects of women's active involvement with their personal social network, which may or may not be spatially concentrated. Other recent studies have found personal social, especially family, networks to be important channels for the social transmission of reproductive behaviour (Balbo & Barban, 2012; Bernardi, 2003; Kotte & Ludwig, 2011). Thus social networks are inter-personal conduits for social learning, depending on active communication between members. As we have suggested above, other forms of social learning are possible where individuals are influenced by those around them in a more passive way. In this respect, the definition of local fertility contexts employed in this study may capture unmeasured passive social learning operating at the local scale, which may impact on different dimensions of fertility behaviour (e.g. on the timing of births within the life course, family size, or even birth spacing). Our purpose is to determine whether such social influences might be predictive of transition to second and/or third births.

4. Data, methods and variables

The empirical analyses use data from the British Household Panel Survey (BHPS)[2] for each year between 1999 and 2008. In 1999 booster samples were drawn in Scotland and Wales to ensure the representativeness of the samples for each of these countries. The core BHPS questionnaire covers a wide range of topics potentially relevant to fertility studies, such as household composition, education, employment, income, health, housing conditions, and residential mobility. These subjects are surveyed annually, whereas others are less frequently included. Information on fertility intentions, for example, is only surveyed in a small number of waves. This precludes the tracking of changes over time in relation to births risks and therefore data on fertility intentions is unsuitable for inclusion in our models. We do, however, include data from the retrospective questions specifically designed to enable the reconstruction of individuals' lifetime marriage, cohabitation and fertility histories (Pronzato, 2010). Furthermore, since the BHPS is a household survey, information is available on all those in the respondents' household. For some individuals' life episodes, the survey records the exact date of start and end, whereas other questions are asked with reference to the time of interview and considered fixed for the entire duration of the wave. Given our present focus on fertility and the role played by the local context of residence, we made explicit use of the information on the exact month the respondents gave birth to a child and the exact month a change of residence took place. All the other variables vary from one wave to another.

The analyses focus on women aged between 16 and 45 at risk of conceiving their second (or third) child in the period between 1999 and 2008. More precisely, the first sample consists of 1649 mothers of one child who are at risk of conceiving their second child for some time during the window of observation. The second sample consists of 1800 mother of two children who are at risk of conceiving their third child during the window of observation. The event under observation is the conception leading to the birth of the second (or third) child. The birth of a child is the actual event recorded in the data, but we *backdated its date of occurrence by 9 months* in order to approximate the conditions of the woman at the time of conception and avoid issues of reverse causation. Time is measured in months since the birth of the previous child. Some women will have been exposed to the risk of a conception before they come under observation. In this case, left-censoring is addressed by making use of the information on the exact date of previous childbirth from the complete retrospective fertility histories. Thus, not all women enter observation when $t_0 = 0$; for some of them t_0 equals the months already elapsed from the previous childbirth. During the time respondents are under observation we observe 600 conceptions leading to second birth and 217 conceptions leading to third birth.

Transitions to second and third order births are first studied separately. To estimate the models, we adopt a piece-wise linear specification of the baseline log-hazard function (Lillard & Panis, 2003), with nodes after 1, 3 and 6 years since the birth of the previous child. The log-hazard function for each birth order can be expressed as follows:

$$\ln h(t, X) = y(t) + \sum \beta X(t),$$

i.e. as a function of a baseline log-hazard, which is assumed to vary at a rate which is constant within each specific interval but varies across intervals, and as a function of the vector of covariates $X(t)$. The model includes both time-constant and time-varying covariates.

The primary variable of interest is the *Local fertility context.* This is a classification of the woman's place of residence, derived from a spatial ecological analysis of fertility levels observed for around 40 thousands small areas in Britain.[3] We used the general fertility rate (GFR) to measure fertility in small areas because it is the best approximation to the ratio of children to potential mothers that a woman might *observe* in the area in which she lives, and is thus in line with our hypothesis on passive social learning. First, GFRs were estimated for each small area using the average count of births from vital events registrations for the year 2000, 2001 and 2002 (to account for year-to-year fluctuations) and the female population

[2] University of Essex. Institute for Social and Economic Research, British Household Panel Survey, Waves 1–18, 1991–2009: Special Licence Access, Lower Layer Super Output Areas and Scottish Data Zones [computer file]. 2nd Edition. Colchester, Essex: UK Data Archive [distributor], August 2010. SN: 6136, http://dx.doi.org/10.5255/UKDA-SN-6136-1.

[3] For England and Wales, these are lower level super output areas (LSOA) (~34 thousands spatial units) and, for Scotland, Data Zones (~6 thousands spatial units).

aged 16–44 from the 2001 Census. Then, methods of spatial cluster analysis were applied to test for the existence of significant spatial variation in General Fertility Rates. The G^* Statistic (Getis & Ord, 1992; Ord & Getis, 1995) was used to determine the extent to which a location is surrounded by a cluster of high or low values. For each area, positive values of G^* that exceed a z-score of 1.645 (the 10% level of statistical significance) indicate that higher than average values of the variable of interest are spatially associated with this location; negative values of G^* less than -1.645 indicate a cluster of lower than average values. Thus, rather than identifying particularly high or low values of the variable of interest, this statistic identifies where significantly higher or lower values tend to cluster together. From the results of the spatial cluster analysis we derived a tripartite classification of local areas into: (a) lower fertility cluster; (b) average fertility cluster; (c) higher fertility cluster (Table 1).

Under the special license agreement, the obtained classification was linked in to the BHPS individual records. We then combined the classification of fertility clusters with an urban rural classification that distinguished large cities from 'other urban' and rural areas, as higher and lower than average fertility clusters tend to be concentrated in proximity to large urban areas. As a consequence, the variable *local fertility context* included in the analysis has the following categories: *large urban area – lower fertility cluster; large urban area – average fertility cluster; large urban area – higher fertility cluster; other urban area; rural area.*

We fit a series of hazard models, the results of which are reported below. Model 1 includes only the specification of the *baseline hazard* and the *local fertility context variable*. Then, groups of predictors are entered stepwise, with the aim of examining the relative contribution of each subset of explanatory variables to explaining fertility differences across contexts.

The second model (Model 2) adds a control for the *woman's age at previous childbirth*, with the following categories: *16–24, 25–29, 30–34, 35 and older*. Model 3 then controls for a set of individual and household characteristics which are usually reported to account for differences in fertility. The variable *marital status* distinguishes between women being *never married*, *married*, *living with a partner*; divorced, separated and widowed women are all part of the residual category *other*. For women living with a partner (either married or cohabiting), the variable further distinguishes whether their partner is in employment or not. This variable is therefore time-varying and is updated once per wave. Next, we include woman's *current educational attainment*, a time-varying variable updated every wave. The variable was obtained by recoding the BHPS variable based on the ISCED international classification to: *up to lower secondary*; *secondary – vocational/technical*; *secondary – leading to further education*; *tertiary*. The woman's *labour force status* is also included as a time-varying variable updated at every wave. It was derived by combining information from the BHPS variables on current economic activity and working hours and has the following categories: *in paid employment – full time*; *in paid employment – part time*; *unemployed*; *other*. Model 3 further controls for woman's *ethnicity* and for the time *period* of the conception. *Ethnicity* is the only time-constant variable and distinguishes between *White* and *Non-white*. *Period* distinguishes between the time period *1999–2003* during which TFR reached an historic low in Britain and the years *2004–2008* when TFR recovered and was on an upward trajectory.

In Model 4 a set of variables is included to account for individuals and their households' housing conditions. These variables are also time-varying. Their values are updated in relation to any change of address, according to the date (year and month) of the move. The respondent's *tenure status* is recorded, differentiating between *ownership*, *social renting*, and *private renting* (including other residual forms of renting). *Type of accommodation* recodes the original answers into the three following categories: *detached or semi-detached house/bungalow*; *terraced house*; and *flat/other*. Lastly, house size is accounted for by the variable *number of rooms*, with the two categories *up to 4* and *5 or more*.

Model 5 investigates the mobility of respondents. A first variable, *mobility episodes*, classifies respondents as *stayers* if they never moved, or if they moved more than 5 years before. If they changed residential location more recently, they are considered *movers*. The variable is time-varying and is updated according to whether or not the respondent has lived in the same house since the last interview, using information on the exact month of any move. Besides mobility histories, the models also include a variable describing the respondents' *expectation to move* with the following categories: *doesn't expect to move*; *expects to move*.

Lastly, Model 6 adds the variable *social exchanges*, which comes from the BHPS question: 'How often do you meet friends or relatives who are not living with you?' The original answers are recoded in two categories: *most days* and *less often (than most days).*

Table 2 presents the distribution of person-months (exposures) and events (occurrences) by the categories of the explanatory variables included in the models and

Table 1
Classification of lower super output areas based on the G^* statistic (10% level of statistical significance). Descriptive statistics.

	Lower fertility cluster	Average fertility cluster	Higher fertility cluster
N. of lower super output areas	4273	32,187	4422
% of total resident population	9.6	78.9	11.5
% of female resident population aged 15–44	10.3	76.8	12.9
General fertility rate (per 1000 women)[a]	35.7	51.8	75.1
Total fertility rate[a]	1.19	1.61	2.19

Sources: ONS and NRS census, year 2001; ONS and NRS Birth Registers, years 2000–2002.
[a] Mean values.

Table 2
Exposure (person-months) and occurrences, by explanatory variables included in the models and by birth order.

	2nd birth				3rd birth			
	Person-months		Births		Person-months		Births	
	Number	%	Number	%	Number	%	Number	%
Age of previous child								
0–1 year	9530	15.6	99	16.5	8021	8.3	37	17.0
1–3 years	12,933	21.1	292	48.7	14,770	15.3	93	42.9
3–6 years	11,343	18.5	144	24.0	18,642	19.2	54	24.9
More than 6 years	27,436	44.8	65	10.8	55,423	57.2	33	15.2
Local fertility context								
Large urban – lower fertility	2470	4.0	25	4.2	4555	4.7	7	3.2
Large urban – average fertility	22,555	36.8	229	38.2	34,824	35.9	72	33.2
Large urban – higher fertility	3275	5.4	33	5.5	3848	4.0	12	5.5
Other urban	25,351	41.4	232	38.7	37,387	38.6	89	41.0
Rural	7591	12.4	81	13.5	16,242	16.8	37	17.1
Woman's age at previous child								
16–24	27,066	44.2	250	41.7	22,450	23.2	92	42.4
25–29	17,096	27.9	179	29.8	35,491	36.6	60	27.6
30–34	12,328	20.1	137	22.8	28,730	29.7	54	24.9
35 and older	4751	7.8	34	5.7	10,185	10.5	11	5.1
Marital status + partner occupation								
Never Married	10,625	17.7	32	5.3	5168	5.3	15	6.9
Married – husband in employment	27,431	44.6	374	62.3	62,758	64.8	129	59.4
Married – husband not in employment	1573	2.6	15	2.5	3957	4.1	10	4.6
Living as couple – partner in employment	13,203	21.5	147	24.5	11,797	12.2	46	21.2
Living as couple – partner not in employment	1847	3.0	22	3.7	1755	1.8	9	4.2
Other	6563	10.7	10	1.7	11,421	11.8	8	3.7
Educational attainment								
Up to lower secondary	8805	14.4	81	13.5	16,791	17.3	41	18.9
Secondary (vocational/technical)	21,406	34.9	188	31.3	34,072	35.2	76	35.0
Secondary (to further education)	8858	14.5	84	14.0	12,131	12.5	29	13.4
Tertiary	22,173	36.2	247	41.2	33,862	35.0	71	32.7
Labour force status								
In paid employment – full time	19,796	32.3	112	18.7	26,653	27.5	19	8.8
In paid employment – part time	23,722	38.7	203	33.8	42,830	44.2	65	29.9
Unemployed	2429	4.0	16	2.7	1996	2.1	8	3.7
Other	15,295	25.0	269	44.8	25,377	26.2	125	57.6
Ethnicity								
White	59,364	96.9	585	97.5	94,001	97.1	211	97.2
Non-white	1878	3.1	15	2.5	2855	2.9	6	2.8
Period								
1999–2003	34,113	55.7	362	60.3	53,118	54.8	114	52.5
2004–2008	27,129	44.3	238	39.7	43,738	45.2	103	47.5
Tenure								
Ownership	42,592	69.5	422	70.3	72,977	75.4	140	64.5
Social rent	217	21.6	126	21.0	18,213	18.8	64	29.5
Private rent/other	5433	8.9	52	8.7	5666	5.8	13	6.0
Type of accommodation								
Detached/semidetached	30,977	50.6	339	56.5	62,798	64.8	126	58.1
Terraced	20,354	33.2	178	29.7	26,729	27.6	63	29.0
Flat/other	9911	16.2	83	13.8	7329	7.6	28	12.9
No. of rooms								
Up to 4	36,170	59.1	318	53.0	39,636	40.9	109	50.2
5 or more	25,072	40.9	282	47.0	57,220	59.1	108	49.8
Mobility episodes								
Stayers	43,200	70.5	379	63.2	75,212	77.6	140	64.5
Movers (moved up to 5 years before)	18,042	29.5	221	36.8	21,644	22.4	77	35.5
Expectancy to move								
No	50,987	83.2	472	78.7	86,319	89.1	183	84.3
Yes	10,255	16.8	128	21.3	10,537	10.9	34	15.7
How often sees family/friends								
Most days	34,382	56.1	355	59.2	50,180	51.8	139	64.1
Less often	26,860	43.9	245	40.8	46,676	48.2	78	35.9
Total	61,242	100.0	600	100.0	96,856	100.0	217	100.0

Data source: British Household Panel Survey 1999–2008.

separately for each birth order. The table shows some notable differences between women at risk of conceiving their second child and those who are at risk of conceiving the third. Compared to mothers who already have one child, women who already have two children have higher proportions of person-months spent living in a marital union, working part time, living in larger owner-occupied family housing and, lastly, not moving (nor expecting to move) house. For those who do go on to have a second or third child, the most common birth spacing is between one and three years after the birth of the previous child. The distribution of births across local fertility contexts is similar for both birth orders, although with a slightly higher proportion of third births to women living in rural areas. In contrast, there are very few third births to women living in lower fertility contexts in large urban areas.

The separate estimation of hazard models for each parity transition, with stepwise introduction of groups of variables, allows us to investigate the relative contributions of different factors to the risks of a second, or third, birth. By accounting for individual characteristics and residential moves, we are able to examine the contribution of local fertility contexts *other things being equal*. However, there might be an additional source of bias if women who become mothers are already a selective group. In order to control for this potential selection bias, the second part of our empirical analysis follows the approach illustrated by Kravdal (2001) and widely applied thereafter. The transitions to first, as well as second and third, birth are estimated simultaneously within a joint model and a common woman-level residual is added. This allows us to control for unmeasured characteristics which might play a role in the self-selection of women into motherhood in the first place, and then into second order parity.

The log-hazard function for each birth order is expressed as follows:

$$\ln h^1(t,X) = y^1(t) + \sum \beta^1 X(t) + \epsilon$$

$$\ln h^2(t,X) = y^2(t) + \sum \beta^2 X(t) + \epsilon$$

$$\ln h^3(t,X) = y^3(t) + \sum \beta^3 X(t) + \epsilon,$$

For first birth, $y^1(t)$ represents the time since the woman turned 16, with nodes at age 20, 25, 30, 35 and 40; for second and third birth, the baseline log-hazard is defined as in the separate models described above. ε is a woman-level residual which follows a normal distribution. $\sum\beta^1 X(t)$ is specified in the same manner for all parity transitions as in the full model (Model (6)). The only (obvious) exception is *woman's age at previous childbirth*, which only enters the equations for second and third order birth.

5. Results

In this section we report the results of our empirical analyses, following the theoretical assumptions and the consequent research questions outlined earlier in the paper. First, results are presented separately for second births (Table 3), and for third births (Table 4). Then, results from the estimation of the joint model for first, second and third births are reported in Table 5.

Among mothers of one child in our sample, the risks of conceiving a second child for the 36% who do so during the period of observation increase steeply in the first year after the birth of the previous child, reflecting women's strategy of relatively short spacing between births. The risks then start to decrease significantly when the first child is older than three years, and they continue to decline when the first child is older than six years. Although being highest for women living in rural areas and lowest for women living in lower fertility clusters in large cities, the risks of conceiving a second child are not significantly different across geographical contexts (Table 3, Model 1).

The birth of the second child is significantly related not only to the age of the first child, but also to the age of mothers at the birth of their first child (Table 3, Model 2). Most notably, women who were 35 or older when they gave birth to their first child are less likely than younger women to progress to the second child. With the inclusion of the socio-demographic characteristics of women and their partners (if any) (Table 3, Model 3), the effect of woman's age at first birth becomes more pronounced: for women who were 25 or older at previous childbirth, the risks of conceiving a second child decrease significantly with age. As expected, the effect of marital status on second birth is highly significant. Being in a union is associated with higher risks of conceiving a second child, whereas women who never married or experienced marital disruption (widowhood, divorce or separation) and are not currently living with a partner are significantly less likely to have a second child. Furthermore, despite the importance of non-marital births in Britain, second births are less likely to occur within a non-marital compared to a marital union. More surprisingly, the risks of conceiving a second child do not appear to be related to the occupational position of the husband/partner, although they tend to be somewhat lower when men are not in employment. Significant differences in the risk of conceiving a second child are, however, associated with women's socio-economic characteristics. We observe a U-shaped curve for the effect of education, with highest risks of second birth for women with educational qualifications up to lower secondary level and for those with university education, but with the only significant difference being the lower risks for women with secondary (vocational and technical) education compared to those with lower secondary or less. Net of education and other factors, women who are unemployed or economically inactive are significantly more likely to conceive a second child than women in employment (either full or part-time). Non-white ethnicity is associated with lower second birth risks. However, despite an upward trend in period fertility at a national scale since 2004, no evidence of differences in second birth risks over time periods can be detected.

The third set of variables included in the model allows us to examine relationships between housing conditions and second birth risks (Table 3, Model 4). Of course, housing size and type (as well as availability and affordability) vary across different spatial contexts, as does fertility across different housing contexts. The

Table 3
Hazard model for the conception leading to second birth. β-coefficients, significance level and standard errors.

	(1)			(2)			(3)			(4)			(5)			(6)		
	β	Sig.	s.e.	*β*	Sig.	s.e.	*β*	Sig.	s.e.	*β*	Sig.	s.e.	*β*	Sig.	s.e.	*β*	Sig.	s.e.
Baseline																		
Age of previous child (slope)																		
Constant	−3.464	***	0.335	−3.452	***	0.337	−3.345	***	0.379	−3.386	***	0.390	−3.448	***	0.391	−3.440	***	0.393
0–1 year	2.133	***	0.311	2.152	***	0.312	2.337	***	0.319	2.331	***	0.319	2.331	***	0.320	2.332	***	0.320
1–3 years	−0.038		0.077	−0.036		0.077	0.057		0.077	0.054		0.078	0.061		0.078	0.061		0.078
3–6 years	−0.373	***	0.061	−0.372	***	0.061	−0.321	***	0.061	−0.323	***	0.061	−0.319	***	0.061	−0.319	***	0.061
More than 6 years	−0.229	***	0.038	−0.241	***	0.038	−0.248	***	0.039	−0.249	***	0.039	−0.247	***	0.039	−0.247	***	0.039
Local fertility context																		
Large urban – lower fertility	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
Large urban – average fertility	0.066		0.217	0.051		0.219	−0.001		0.215	−0.034		0.217	−0.037		0.218	−0.041		0.218
Large urban – higher fertility	0.078		0.266	0.038		0.268	0.000		0.257	−0.048		0.262	−0.055		0.263	−0.059		0.263
Other urban	0.015		0.217	−0.027		0.219	−0.119		0.215	−0.151		0.217	−0.148		0.217	−0.150		0.217
Rural	0.132		0.234	0.170		0.237	0.029		0.233	−0.018		0.235	−0.003		0.236	−0.004		0.236
Woman's age at previous childbirth																		
16–24				Ref.			Ref.			Ref.			Ref.			Ref.		
25–29				0.186	*	0.101	−0.192	*	0.114	−0.206	*	0.116	−0.197	*	0.117	−0.196	*	0.117
30–34				−0.024		0.107	−0.400	***	0.125	−0.435	***	0.129	−0.425	***	0.130	−0.421	***	0.131
35 and older				−0.690	***	0.180	−1.102	***	0.194	−1.153	***	0.198	−1.121	***	0.199	−1.117	***	0.200
Marital status + partner occupation																		
Never Married							−2.074	***	0.195	−2.075	***	0.205	−2.087	***	0.206	−2.087	***	0.206
Married – husband in employment							Ref.			Ref.			Ref.			Ref.		
Married – husband not in employment							−0.234		0.245	−0.249		0.252	−0.264		0.254	−0.262		0.254
Living as couple – partner in employment							−0.530	***	0.104	−0.523	***	0.108	−0.529	***	0.108	−0.528	***	0.108
Living as couple – partner not in employment							−0.827	***	0.236	−0.841	***	0.244	−0.871	***	0.244	−0.869	***	0.244
Other							−1.604	***	0.339	−1.574	***	0.342	−1.591	***	0.343	−1.591	***	0.343
Educational attainment																		
Up to lower secondary							Ref.			Ref.			Ref.			Ref.		
Secondary (vocational/technical)							−0.145		0.137	−0.139		0.139	−0.135		0.140	−0.135		0.140
Secondary (to further education)							−0.315	*	0.163	−0.305	*	0.164	−0.308	*	0.166	−0.308	*	0.166
Tertiary							0.085		0.143	0.094		0.146	0.086		0.147	0.088		0.148
Labour force status																		
In paid employment – full time							Ref.			Ref.			Ref.			Ref.		
In paid employment – part time							0.135		0.124	0.131		0.124	0.137		0.124	0.137		0.124
Unemployed							0.613	**	0.277	0.609	**	0.280	0.600	**	0.281	0.599	**	0.281
Other							0.972	***	0.118	0.962	***	0.119	0.956	***	0.119	0.955	***	0.119
Ethnicity																		
White							Ref.			Ref.			Ref.			Ref.		
Non-white							−0.469	*	0.273	−0.485	*	0.274	−0.475	*	0.277	−0.470	*	0.277
Period																		
1999–2003							Ref.			Ref.			Ref.			Ref.		
2004–2008							−0.053		0.084	−0.055		0.084	−0.094		0.092	−0.094		0.092
Tenure																		
Ownership										Ref.			Ref.			Ref.		

Table 3 (*Continued*)

	(1)			(2)			(3)			(4)			(5)			(6)		
	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.
Social rent										0.162		0.133	0.140		0.134	0.138		0.134
Private rent/other										−0.097		0.167	−0.142		0.169	−0.142		0.170
Type of accommodation																		
Detached/semidetached										Ref.			Ref.			Ref.		
Terraced										−0.021		0.098	−0.022		0.100	−0.021		0.100
Flat/other										−0.040		0.141	−0.059		0.141	−0.057		0.141
No. of rooms																		
Up to 4										Ref.			Ref.			Ref.		
5 or more										0.199	**	0.098	0.196	**	0.098	0.196	**	0.098
Mobility episodes																		
Stayers													Ref.			Ref.		
Movers (moved up to 5 years before)													0.121		0.097	0.121		0.097
Expectancy to move																		
No													Ref.			Ref.		
Yes													0.166		0.108	0.168		0.108
How often sees family/friends																		
Most days																Ref.		
Less often																−0.023		0.086
Log-likelihood	−3133.95			−3120.92			−2984.2			−2980.52			−2978.51			−2978.47		
No. of births	600																	
No. of women	1649																	
No. of person-months	61,242																	

Data source: British Household Panel Survey 1999–2008.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table 4
Hazard model for the conception leading to third birth. β-coefficients, significance level and standard errors.

	(1)			(2)			(3)			(4)			(5)			(6)		
	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.
Baseline																		
Age of previous child (slope)																		
Constant	−3.713	***	0.491	−2.793	***	0.491	−3.669	***	0.591	−3.738	***	0.612	−3.777	***	0.615	−3.746	***	0.619
0–1 year	0.862	**	0.425	0.890	**	0.432	1.024	**	0.447	1.029	**	0.451	1.020	**	0.451	1.033	**	0.453
1–3 years	−0.089		0.127	−0.076		0.128	−0.016		0.130	−0.016		0.133	−0.008		0.134	−0.008		0.134
3–6 years	−0.407	***	0.091	−0.407	***	0.091	−0.354	***	0.094	−0.350	***	0.096	−0.343	***	0.097	−0.343	***	0.097
More than 6 years	−0.246	***	0.060	−0.285	***	0.061	−0.269	***	0.065	−0.274	***	0.065	−0.273	***	0.066	−0.270	***	0.066
Local fertility context																		
Large urban – lower fertility	Ref.			Ref.			Ref.			Ref.			Ref.			Ref.		
Large Urban – average fertility	0.217		0.389	0.197		0.382	0.129		0.386	0.210		0.403	0.194		0.405	0.184		0.404
Large urban – higher fertility	0.582		0.483	0.152		0.493	−0.034		0.508	0.099		0.528	0.093		0.528	0.077		0.528
Other urban	0.395		0.385	0.296		0.379	0.236		0.380	0.314		0.401	0.305		0.402	0.293		0.402
Rural	0.335		0.406	0.420		0.396	0.391		0.397	0.476		0.415	0.474		0.416	0.468		0.415
Woman's age at previous childbirth																		
16–24				Ref.			Ref.			Ref.			Ref.			Ref.		
25–29				−0.933	***	0.173	−0.960	***	0.181	−0.967	***	0.185	−0.949	***	0.186	−0.944	***	0.187
30–34				−1.273	***	0.177	−1.308	***	0.197	−1.330	***	0.203	−1.311	***	0.203	−1.306	***	0.206
35 and older				−2.142	***	0.335	−2.209	***	0.354	−2.244	***	0.360	−2.203	***	0.361	−2.190	***	0.363
Marital status + partner occupation																		
Never married							−0.679	**	0.304	−0.633	*	0.326	−0.621	*	0.326	−0.631	*	0.326
Married – husband in employment							Ref.			Ref.			Ref.			Ref.		
Married – husband not in employment							0.072		0.318	0.127		0.332	0.117		0.334	0.124		0.336
Living as couple - Partner in employment							0.056		0.177	0.075		0.186	0.066		0.186	0.063		0.188
Living as couple – partner not in employment							−0.270		0.382	−0.232		0.390	−0.227		0.393	−0.223		0.395
Other							−0.631		0.395	−0.603		0.412	−0.622		0.416	−0.613		0.419
Educational attainment																		
Up to lower secondary							Ref.			Ref.			Ref.			Ref.		
Secondary (vocational/technical)							0.007		0.208	0.021		0.210	0.014		0.211	0.014		0.211
Secondary (to further education)							−0.017		0.257	−0.004		0.266	−0.017		0.266	−0.013		0.266
Tertiary							0.321		0.222	0.319		0.229	0.311		0.229	0.313		0.228
Labour force status																		
In paid employment – full time							Ref.			Ref.			Ref.			Ref.		
In paid employment – part time							0.199		0.274	0.201		0.275	0.212		0.278	0.204		0.278
Unemployed							1.232	***	0.463	1.208	**	0.482	1.212	**	0.482	1.225	**	0.483
Other							1.076	***	0.267	1.085	***	0.270	1.087	***	0.272	1.081	***	0.272
Ethnicity																		
White							Ref.			Ref.			Ref.			Ref.		
Non-white							−0.231		0.426	−0.271		0.448	−0.267		0.453	−0.253		0.454
Period																		
1999–2003							Ref.			Ref.			Ref.			Ref.		
2004–2008							0.153		0.141	0.182		0.142	0.124		0.152	0.122		0.152
Tenure																		
Ownership										Ref.			Ref.			Ref.		

Table 4 (*Continued*)

	(1)			(2)			(3)			(4)			(5)			(6)		
	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.	β	Sig.	s.e.
Social rent										−0.028		0.215	−0.015		0.218	−0.020		0.218
Private rent/other										−0.542		0.348	−0.571		0.350	−0.578		0.350
Type of accommodation																		
Detached/semidetached										Ref.			Ref.			Ref.		
Terraced										−0.107		0.176	−0.109		0.177	−0.114		0.177
Flat/other										0.318		0.277	0.318		0.284	0.305		0.285
No. of rooms																		
Up to 4										Ref.			Ref.			Ref.		
5 or more										0.005		0.166	−0.001		0.167	−0.006		0.167
Mobility episodes																		
Stayers													Ref.			Ref.		
Movers (moved up to 5 years before)													0.189		0.158	0.189		0.158
Expectancy to move																		
No													Ref.			Ref.		
Yes													−0.001		0.213	0.006		0.213
How often sees family/friends																		
Most days																Ref.		
Less often																−0.076		0.153
Log-likelihood	−1429.87			−1385.35			−1360.00			−1356.66			−1355.94			−1355.81		
No. of births	217																	
No. of women	1800																	
No. of person-months	96,856																	

Data source: British Household Panel Survey 1999–2008.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

Table 5
Hazard model for the conception leading to first, second and third birth. Joint model with a common unobserved heterogeneity term. β-coefficients, significance level and standard errors.

	First birth			Second birth			Third birth		
	Coeff.	Sig.	s.e.	Coeff.	Sig.	s.e.	Coeff.	Sig.	s.e.
Baseline									
Woman's age (slope)									
Constant	−1.798	***	0.354						
16–19	0.109		0.073						
20–24	−0.157	***	0.040						
25–29	0.114	***	0.037						
30–34	−0.142	***	0.042						
35–39	−0.307	***	0.080						
40 and older	−0.792	**	0.317						
Age of previous child (slope)									
Constant				−3.669	***	0.439	−3.924	***	0.645
0–1 year				2.402	***	0.341	1.070	**	0.473
1–3 years				0.122		0.083	0.026		0.138
3–6 years				−0.305	***	0.063	−0.329	***	0.099
More than 6 years				−0.257	***	0.041	−0.273	***	0.067
Local fertility context									
Large urban – lower	Ref.			Ref.					
Large urban – average	0.386	**	0.180	−0.019		0.238	0.176		0.416
Large urban – high	0.163		0.254	−0.019		0.293	0.046		0.552
Other urban	0.455	**	0.182	−0.129		0.237	0.294		0.414
Rural	0.411	**	0.205	0.021		0.256	0.475		0.428
Woman's age at previous childbirth									
16–24				Ref.			Ref.		
25–29				−0.219	*	0.130	−0.972	***	0.198
30–34				−0.447	***	0.144	−1.353	***	0.217
35 and older				−1.180	***	0.218	−2.279	***	0.387
Marital status + partner occupation									
Never married	−2.825	***	0.146	−2.202	***	0.221	−0.642	*	0.339
Married – husband in employment	Ref.			Ref.			Ref.		
Married – husband not in employment	−0.844	***	0.305	−0.316		0.274	0.124		0.345
Living as couple – partner in employment	−1.226	***	0.115	−0.560	***	0.119	0.053		0.196
Living as couple – partner not in employment	−1.591	***	0.212	−0.921	***	0.258	−0.239		0.414
Other	−1.909	***	0.485	−1.652	***	0.358	−0.623		0.432
Educational attainment									
Up to lower secondary	Ref.			Ref.			Ref.		
Secondary (vocational/technical)	−0.149		0.146	−0.141		0.155	−0.008		0.223
Secondary (to further education)	−0.486	***	0.175	−0.331	*	0.184	−0.030		0.279
Tertiary	−0.265	*	0.158	0.098		0.164	0.296		0.240
Labour force status									
In paid employment – full time	Ref.			Ref.			Ref.		
In paid employment – part time	0.413	***	0.131	0.148		0.131	0.229		0.282
In education	−1.171	***	0.286						
Unemployed	0.970	***	0.168	0.643	**	0.293	1.253	**	0.502
Other	2.282	***	0.104	1.030	***	0.128	1.138	***	0.276
Ethnicity									
White	Ref.			Ref.			Ref.		
Non-white	−0.531	**	0.248	−0.503	*	0.300	−0.243		0.481
Period									
1999–2003	Ref.			Ref.			Ref.		
2004–2008	−0.185	**	0.090	−0.086		0.099	0.090		0.158
Tenure									
Ownership	Ref.			Ref.			Ref.		
Social rent	0.478	***	0.134	0.149		0.146	−0.049		0.228
Private rent/other	−0.388	***	0.144	−0.162		0.182	−0.614	*	0.361
Type of accommodation									
Detached/semidetached	Ref.			Ref.			Ref.		
Terraced	−0.123		0.098	−0.025		0.108	−0.131		0.184
Flat/other	−0.343	***	0.130	−0.069		0.150	0.312		0.299
No. of rooms									
Up to 4	Ref.			Ref.			Ref.		

Table 5 (*Continued*)

	First birth			Second birth			Third birth		
	Coeff.	Sig.	s.e.	Coeff.	Sig.	s.e.	Coeff.	Sig.	s.e.
5 or more	0.152		0.093	0.208	**	0.105	0.005		0.173
Mobility episodes									
Stayers	Ref.			Ref.			Ref.		
Movers (moved up to 5 years before)	0.250	**	0.097	0.102		0.105	0.164		0.164
Expectancy to move									
No	Ref.			Ref.			Ref.		
Yes	0.467	***	0.097	0.155		0.114	0.001		0.219
How often sees family/friends									
Most days	Ref.			Ref.			Ref.		
Less often	−0.168	*	0.086	−0.018		0.091	−0.074		0.158
Standard deviation of residuals	0.437***								
No. of births	656			600			217		
No. of women	3842			1649			1800		
No. of person-months	155,888			61,242			96,856		

Data source: British Household Panel Survey 1999–2008.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

inclusion of housing variables has only a marginal effect on the differences across local fertility contexts, and none on the other variables. We find however that housing size is positively associated with higher second birth risks. This is hardly surprising but it is interesting bearing in mind that the variable measures housing size prior to the conception of a second child. We cannot tell from the model whether having a larger house encourages a couple to have more children or whether intending to have more children prompts a couple to find a larger house, but it is clear that living in smaller housing is associated with a lower risk of having a second child. We find no significant differences across tenure categories; risks appear higher for women living in social housing compared to women who own their house, and lower for women living in flats, but these are not significant determinants of second birth.

In the penultimate model, two variables related to mobility are included (Table 3, Model 5). Since housing size prior to conception is found to be a significant determinant of second birth risks, and since it is possible that those intending to have two or more children selectively move in to areas with a stock of larger family housing well in advance of having a child/ren, we included a variable distinguishing those who had changed residence in the past 5 years from those who had not (stayers). This variable acts as a control for the effect of selective residential relocation, but we do not find that women who had changed house in the last 5 years have a significantly different risk of conceiving a second child compared with stayers. Model 5 also includes an indicator for who was expecting to move in the following year, but again we observe no statistically significant difference in second birth risks compared to women who said they did not intend to move. The inclusion of the two migration variables has very little impact on the associations already reported between all the other variables and second birth risks.

Lastly, Model 6 adds a variable measuring the frequency of women's social interactions with family and friends (Table 3, Model 6) as a marker of opportunities for active social learning. We find that risks of conception leading to second birth do not differ significantly between women with more or less frequent social exchanges. However, this variable is included specifically to isolate the effects of active involvement in inter-personal interactions from the hypothesized role of passive social learning in local fertility contexts. Again, the inclusion of this variable has minimal impact on the main relationships identified above.

In sum, the transition to second child is closely related to the socio-demographic profile of mothers. Most notably, women who became mothers at younger ages, who are married and who are not in employment show the highest risks of conceiving a second child. Local fertility contexts do not have a significant effect on second birth risks either before or after adjustment for other factors. Rather, the differences across contexts fluctuate close to the reference category, with all the log risks in Model 6 being very close to 0 (Table 2, Model 6). Thus, second birth risks seem not to be affected by the local fertility context where the woman lives. This is not surprising, as we shall discuss later on, given that social influences have been reported to be more important in relation to the earlier transition to motherhood, and the widespread reluctance of British mothers to adopt the one-child family model.

Table 4 reports the estimates of the hazard model on conceptions leading to third birth and follows the same strategy of stepwise introduction of variables used in the models for second birth risks. Around 12% of mothers of two children in our sample give birth to a third child over the period in which they are under observation. Again, conceptions tend to be concentrated between one and three years after the birth of the second child. We do not observe any statistically significant difference in the log-hazard of third birth across local fertility contexts. Thus, as with second births, local fertility contexts do not appear to influence the transition to third birth.

Model 2 (Table 4) shows the important effect of woman's age at previous childbirth. Women are significantly less likely to progress to higher parities if they were older than 25 when they gave birth to their second child. The coefficients for woman's age at previous childbirth are strengthened in Model 3, which includes the socio-economic characteristics of women and their partners. Compared to what was observed for second births, marital status is not a significant predictor of third birth risks, perhaps also due to the very small numbers of mothers of two children who have never married. Risks of a third child are significantly lower only for never married women who are currently not in a union. Similarly to the previous parity transition, higher risks of conceiving a third child are observed for unemployed and economically inactive women. Educational attainment, ethnicity and period are not significant (Table 4, Model 3).

Different housing characteristics (Table 4, Model 4) are also not significantly associated with the hazard of a third birth, with the only exception being a lower risk for women living in private rented accommodation. Women who changed house in the last five years are not significantly more likely to conceive a third child compared with stayers, despite a higher log-hazard for movers (Table 4, Model 5). Lastly, frequent social exchanges (Table 4, Model 6) with family and friends do not affect the risks of conception leading to the birth of a third child.

While the separate models for second and third births risks enable an examination of the cumulative effects of the explanatory variables on each of these transitions, they do not account for unmeasured characteristics which may influence women's reproductive behaviour and in particular their selection into motherhood. The final model, therefore, jointly estimates the hazards of first, second and third birth (Table 5), including a common woman-level residual. The positive and statistically significant standard deviation of the residuals points to the existence of unobserved factors affecting women's fertility.

Furthermore, the inclusion of a woman-level residual affects to a certain extent the size of the estimated coefficients for some of the woman's individual characteristics. In particular, controlling for women's self-selection into motherhood, the negative effect of employment on fertility becomes even more pronounced. The general picture for second and third order births, however, remains unaltered, as the direction and statistical significance of the other coefficients do not change, nor do contextual differences become more appreciable. Lastly, the joint estimation of the three parity transitions allows us to compare transitions to second and third order birth to that into motherhood. Again, women's socio-demographic characteristics are important predictors of the transition to first birth. However, the birth of a first child responds to a broader set of influences, being significantly associated with housing characteristics and both realized and intended residential moves. Most importantly, results for first birth show significant variation across local contexts: women living in lower fertility contexts within large cities stand out as having later transitions to first birth. This relation still holds even after controlling for the (significant and positive) effect of the frequency of women's social exchanges with family and friends.

6. Discussion

This paper contributes to the study of spatial variations in fertility and the underlying processes by examining individual parity transitions of women in Britain in the early 21st century. Specifically, it advances our understanding by observing transitions to second and third order births across local contexts. Understanding these transitions is important in relation to both national level fertility trends and the implications for natural population growth or decline in local areas.

The study investigates the main drivers of individuals' parity transitions and the processes that lie behind any observed differences across local contexts. Three research questions lead the analyses. First, we ask whether transitions to second, and third, birth vary across local fertility contexts. The second research question addresses compositional and selection effects, which have been regarded as confounders for contextual effects. Our analyses therefore seek to incorporate all three paths of influence put forward in the literature explaining geographical differences: the composition, the contextual and the selection hypothesis. The aim is to ascertain whether observed differences are attributable to the geographical distribution of women (and their partners) with different socio-demographic characteristics, to housing characteristics, to selective mobility, and/or to social influences attributable to the local context. The final research question addresses the possibility of additional sources of social influence on individual behaviours by focusing on the role of inter-personal interactions. In so far as frequent contact with family and friends is spatially concentrated in a local area, such effects may confound the relationship between fertility context and parity transition, which we hypothesize as a more passive process of social learning.

Results from the hazard models show that the local fertility contexts in which women live have no impact on their relative risk of conception leading to a second birth. It seems that the decision to have a second child is not responsive to local contextual influences. The same observation can be made for third births. These findings are not surprising and indeed in line with most literature on spatial variations of fertility, which shows that differences across contexts are less prominent with respect to higher order births than they are for first births. Recent work on Britain using different geographical categories (Kulu, 2013b) similarly reports the absence of spatial variation in second birth risks but does find some significant difference in third birth risks, with women living cities having lower risks. Given the relatively small number of third births to women living in lower fertility contexts in large urban areas in our study, future research using a larger sample could usefully explore this further.

In relation to the second research question, the study demonstrates that both the transition to second, and to third, child are significantly associated with women's (and their households') socio-demographic characteristics.

A woman's age, marital status and partner's employment, as well as her labour force status, are important predictors of transitions to both second and third order births. Overall, individual characteristics show the same direction of influence on both parity transitions, although they differ with respect to their magnitude and significance. For instance, the differences between women in and not in employment are more pronounced with respect to third births than they are for second births. Although difficulties of combining work and motherhood within the British setting are evident at all stages of a woman's life course, they appear to have greater weight in influencing the decision to have a third child.

Alongside individual-level characteristics, our study also considers the role of housing. Previous research on Britain highlighted the role of homeownership for fertility decisions (Clark & Huang, 2003; Hakim, 2003; Ineichen, 1981) and recognized tenure as an axis of social stratification with substantial discriminatory power with respect to fertility behaviour. Our study not only considers whether and how fertility risks vary across tenure categories but also takes other aspects of housing into account, namely size and type of accommodation. Two findings reveal the existence of differences in second and third birth risks by housing characteristics. First, second births occur more often to women living in larger housing but there is no relationship between house size and the risk of a third birth. The inclusion of local fertility context in the models distinguishes between urban and rural areas and therefore accounts for some of the geographical differences in house size and tenure. Nevertheless, it is couples already living in more spacious houses who are more likely to have a second child, suggesting that house size is adjusted to fertility aspirations at an early stage of family formation. Secondly, we find that women living in privately rented accommodation are less likely to go on to have a third child. This is unsurprising in the light of the specificity of the British setting, where home-ownership is normative and typically considered a prerequisite for parenthood (Mulder & Billari, 2010; Murphy & Sullivan, 1985). In our study, 70% of second births and 65% of third births are to couples living in owner-occupied housing (Table 2 above). Private rented accommodation is more likely to be regarded as temporary and unsuitable for raising a larger family.

If couples move house in anticipation of extending their family, as suggested by the association between larger housing and second birth risks, then selection effects may also be important. Our study acknowledges that patterns of selective relocation might be partly responsible for the differences in fertility across spatial contexts. Although families with children are usually reluctant to make long-distance moves (Kulu, 2005, 2008), short-distance moves – particularly those towards the suburbs or rural areas – are often made in association with changes in household composition (Clark & Huang, 2003; Clark & Onaka, 1983; Feijten & Mulder, 2002). However, results show that neither the birth of the second or the third child is significantly associated with a residential move in the five years preceding conception. Nor are birth risks associated with the expectation of moving house in the following year, again suggesting that decisions about where to live are more often made at an earlier stage in the family building process.

The last research question we investigated is explicitly directed towards the identification of active sources of social influence on parity transitions. In hypothesizing that local fertility contexts influence fertility behaviour through processes of social learning, we recognize that informal interactions with others may be either through verbal exchanges or observation (Rossier & Bernardi, 2009). Verbal exchanges take place predominantly within personal social networks, and several studies have shown that fertility decisions are often prompted by births to other members of an individual's network (Bernardi, 2003; Bernardi, Keim, & von der Lippe, 2007; Keim, Klärner, & Bernardi, 2009). Further, the stronger an individual's involvement in active social exchanges with others, the more likely they are to be influenced by the views and behaviour of others in their social network. Our analyses tested this relationship by considering the frequency of women's face-to-face contact with family and friends. The results, however, provide no evidence of a relationship between contact frequency and either second or third birth risks. It is possible that modes of communication other than meeting in person are also important but, while verbal exchanges can be expected to play a role in resolving uncertainties associated with entry into motherhood (Bernardi, 2003; Lyngstad & Prskawetz, 2010), they may be less influential at higher parities.

Our hypothesized mechanism linking local fertility contexts to births risks relies not on verbal exchanges but on observations of others living in the same residential area. The absence of a contextual effect on transitions to second and third child may also reflect the weaker influence of social learning on higher order births. We would not expect the decision to have another child to be comparable to the decision to start a family. Moreover, women at risk of a second or third birth are a select group, insofar as they have already made the transition into motherhood and thus demonstrated a positive orientation towards family formation. This is another source of potential selection bias in our models, which we address by jointly modelling three parity transitions – for first, second and third births – allowing us to obtain unbiased estimates of the hazards of a second and third birth, and of the effects of the independent variables. Furthermore, we are able to derive a more complete picture of the spatial variation of fertility throughout the life course. Indeed, broadening our attention to the transition into motherhood, we observe that the local fertility context is clearly significant in shaping first birth risks, which are markedly lower in lower fertility contexts within large cities compared with elsewhere. Women within lower fertility contexts in large urban areas are more likely to remain childless or, if they do become mothers, to have their first child at a later age (Graham et al., 2012). Then, as we have seen, when women proceed to have their second child, this is most likely to occur from one to three years after the birth of the first child, and almost certainly before the child turns six. Social exchanges with family and friends do not affect this generalized pattern, nor does the local fertility context play a role. These findings are not unexpected as differences between first and higher order births in the extent to which social interactions influence birth risks have also been identified in other studies. In a recent study of siblings' effects on fertility, for example, Lyngstad and Prskawetz (2010) argued that if more general norms exist (for instance a preference for close spacing of first and second births), then the transition to the second birth would respond to this broader normative expectation and there will be little room for inter-siblings effects. The same could be said for processes of passive social learning.

In Britain there is a 'reluctance of women to embrace the one-child family' (Jefferies, 2001) and a tendency for couples to have at least two children, if any (Office for National Statistics, 2012; Shkolnikov et al., 2007; Sigle-Rushton, 2008). Most women who become mothers, irrespective of their personal or contextual characteristics, go on to have a second child; national cohort estimates show that less than twenty per cent of women stop at one (Chamberlain & Smallwood, 2004; Office for National Statistics, 2012). Thus, it seems that women (and their partners) in our sample adhere to a widely shared two-child norm with spacing of around two years between births, although at different ages in the life course. Then, for the minority of women who go on to have a third child, similar birth spacing is evident; risks are highest between one and three years after the second birth and fall to low levels after the second child is six years old. If parenthood is not ultimately foregone, women tend to space births relatively closely. Age at first birth is thus crucial in setting the pattern of childbearing across the life course.

Our findings indicate that age at the onset of a woman's reproductive career sets the course for her subsequent fertility and its life course tempo – with one qualification. A late start to childbearing is associated with lower chances of achieving higher parities as the risks of second and, especially, third birth decline if the woman was over 25 at the birth of her previous child, and decline substantially if she was over 35. In general, however, the significant influence of local fertility context on risks of first birth, after accounting for individual-level characteristics, housing characteristics, residential moves and frequency of social exchanges, continues to impact on higher order births through dominant spacing effects, which determine the timing of second and third births within a woman's life course. Local fertility context appears to have no independent effect on either second or third birth risks, suggesting that processes of social learning are not geographically differentiated in relation to a second or third child.

In the introduction, we made explicit reference to social interaction theories. However, in spite of the wide recognition of their value for understanding divergences in the demographic behaviour of different populations, and notwithstanding their explicit reference to a level ''beyond the individual, but below the abstract national aggregates'' (Kohler, 2000, p. 223) which influences fertility behaviour through social exchanges among individuals, very few studies so far have given serious consideration to the local geographical context as a potential space for social learning (Boyle et al., 2007; Graham et al., 2012). It might be argued that social interactions are not spatially constrained. We contend, however, that 'local' behaviour in respect of fertility represents a social context potentially influential in shaping individual attitudes and behaviours. The exposure to the experiences of others living nearby is likely to promote and reinforce attitudes in relation to the timing and quantum of fertility, as well as contexts for 'proper' motherhood (Bernardi, 2003). Within local contexts, individuals learn from (often passively and unintentionally) the life experiences of others, and this in turn shapes their perceptions of 'normal' behaviour.

Three important limitations of the study should be recognized. First, the data available in the British Household Panel Survey sometimes provide less-than-ideal measures for the constructs we wish to include in the analytical models. For example, no detail is provided on inter-relationships within an individual's social network, and we are therefore only able to include a general indicator of frequency of interaction. Secondly, in spite of acknowledging that mechanisms of selection might be at force, our analysis is able to capture them only partially. The models control for moves and expectations to move, and the findings provide support for the idea of anticipation and adjustment effects, in particular around the time of the first birth. However, future research could be directed to a more explicit examination of the potential endogeneity of fertility and residential choices by analysing these together (Kulu, 2005; Michielin, 2004). Thirdly, our understanding of the mechanisms and of their causal direction could be further enhanced by investigating the potentially moderating effect of fertility intentions. Growing up in a particular local fertility context, for example, might shape future fertility behaviour by influencing an individual's fertility intentions. It is also possible that fertility intentions change over time partly in response to where an individual is living. On the other hand, if observing the fertility behaviour of others in the same local area influences the transition to motherhood as our results suggest, then social learning processes may have a more immediate effect. The BHPS does not include appropriate data for a detailed examination of dynamic relationships between fertility intentions and fertility behaviour. What we have been able to do in this study is investigate the impacts of local fertility contexts on fertility behaviour by considering where women were living shortly before conception, at the time when couples were deciding to have a child. The extension of our study to assess whether (changing) fertility intentions are associated with exposure to (different) local fertility contexts and thus impact on fertility behaviour could be a fruitful direction for future research.

7. Conclusions

Individual reproductive life paths respond to a variety of social processes acting at various scales. Our findings indicate that these influences vary by birth order. While the transition to parenthood may be strongly encouraged by the closeness of a network of family and friends, for example, the transition to second child in Britain appears to respond to more widely shared birth spacing patterns. Similarly, the local fertility context influences transition to first birth but not transition to higher order births, which are mainly associated with individual characteristics of women and their partners rather than where they live. Lower fertility contexts within large cities can be seen as discouraging parenthood and supporting alternative lifestyles, with those women who do become mothers tending to have their first births at a later age compared to those living in other contexts (Graham et al., 2012). Thus local context has an indirect impact on second and third births through age at the onset of childbearing.

The originality of the study lies both in its use of a theoretically-informed geography of local context and its inclusion of a wider range of co-variates in the analysis compared to previous studies. Most past work on fertility variations across space fails to transcend standardized geographies defined by larger-scale administrative boundaries and to consider the processes through which local areas might impact on fertility behaviour. We have suggested that social learning from others in the immediate socio-spatial context surrounding individuals is a plausible mechanism. The central hypothesis is that women are influenced prior to conception by the observation of the fertility behaviour of those around them. This led us to define local context according to the general fertility behaviour of women in small areas and to identify clusters of neighbouring areas which stand out for their relatively low or high fertility levels. The resultant geography, we maintain, is meaningfully associated with fertility decisions in a way that a priori taxonomies are not. Further, by including not only housing tenure (which may be interpreted as a marker for individual socio-economic status) but also house type and size, we capture elements of the local built environment that could be expected to vary spatially and might confound the relationship of interest between local context and fertility events. Indeed, the contribution of the study to the explanation of spatial variations in fertility relates precisely to the appreciation, and the interpretation, of contextual influences at the local level.

Understanding the processes underlying subnational fertility variations is challenging. In their study of German fertility, Basten et al. (2012) demonstrated that empirical findings are sensitive to the size of the geographical unit used in the analysis, and argued that a fine-grained geographical scale is needed to gain a deeper understanding of the relationships involved. Although their study recognized the embeddedness of fertility decisions in local social contexts, available data limited their empirical investigation. In this paper, we have argued that more attention needs to be given both to how 'local social contexts' are defined and to the processes that might link these contexts to fertility behaviour. In Britain, different processes appear to influence transitions to motherhood and transitions to second or third births, and it is important to tease out the geographical scales at which these processes operate and the extent to which they vary between, as well as within, countries. For Finland, Kulu (2013a) showed that selective migration does not explain urban-rural fertility differences, as is often assumed, and that residential context does matter. He argued that 'cultural-normative' factors account for the relatively high third birth levels found in rural areas and small towns, with populations in these local contexts constituting "a subculture with a value orientation towards large families" (Kulu, 2013a, p. 909). Nonetheless, the extent to which fertility subcultures can be spatially defined remains uncertain. Future research should focus on uncovering those aspects of fertility that are subject to local influences and the processes that perpetuate local subcultures. Data limitations impose important constraints on such analyses that will only be addressed by improved data sets. However, as our study highlights, it is also important to consider social interaction theories when analysing spatial fertility differences. The development of ideas of social learning and their extension to scale-sensitive spatial contexts should constitute a key focus for future research. If the local fertility context acts as a space for (passive) social learning, then the acknowledgement and integration of its role within fertility theories could prove beneficial for the understanding of subnational variations in fertility.

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